

WHAT IS CLAIMED IS:

1           1. An aerosol sample detection system comprising:  
2           a sample collector removably attachable to a vehicle and comprising:  
3           a housing having an interior;  
4           a plurality of passages formed in the housing and configured to simultaneously  
5 provide multiple flows of aerosol sample into the interior thereof from ambient; and,  
6           a sample plate removably mounted in the interior of the housing downstream  
7 of the plurality of passages and having a sample surface, which is juxtaposed with the  
8 plurality of passages, the sample plate and the plurality of passages being displaceable relative  
9 to one another so that multiple concentric tracks of collection spots of the aerosol sample are  
10 formed on the sample surface upon impacting the multiple flows of the aerosol sample  
11 thereagainst.

1           2. The aerosol sample detection system of claim 1, further comprising a pressure  
2 source mounted in the housing downstream from the sample plate and including a fan or a  
3 pump to provide pressure differential between the interior of the housing and the ambient,  
4 which is sufficient to force air along the plurality of passages into the interior of the housing.

1           3. The aerosol sample detection system of claim 1, further comprising a multi-channel  
2 time of flight (TOF) mass analyzer removably coupled to the sample plate and provided with  
3 multiple channels, wherein the multiple concentric tracks on the sample surface each are  
4 indexed through a respective one of multiple channels of the TOF mass analyzer.

1           4. The aerosol sample detection system of claim 1, further comprising a drive  
2 mounted in the housing and removably coupled to the sample plate rotatable so that the  
3 plurality of passages each have a respective downstream outlet port facing the sample surface  
4 and controllably juxtaposed with the collection spots of the multiple concentric tracks.

1           5. The aerosol sample detection system of claim 4, wherein the drive is a stepper  
2 motor coupled to the sample plate.

1           6. The aerosol sample detection system of claim 5, wherein the sample plate is disk-  
2 shaped and is rotatably fixed to a shaft of the stepper motor.

1           7. The aerosol sample detection system of claim 4, wherein the collection spots of  
2 each of the multiple concentric tracks are spaced uniformly from one another at a respective  
3 angular distance, the uniform angular distance between the collections spots of one of the  
4 multiple concentric tracks being different from the uniform angular distance between the  
5 collection spots of another one of the multiple concentric tracks.

1           8. The aerosol sample detection system of claim 4, wherein the collection spots of the  
2 multiple concentric tracks are arranged to have each of the collection spots of one of the  
3 multiple concentric tracks aligned with and spaced across the sample plate from a respective  
4 collection spot of another one of the concentric tracks, wherein the aligned and spaced apart  
5 collections spots of the concentric tracks are impinged simultaneously by the multiple flows  
6 of aerosol sample exiting the outlet ports of the plurality of passages to allow for redundancy  
7 in collection of the aerosol sample on the sample surface of the sample plate.

1           9. The aerosol sample detection system of clam 5, wherein the sample surface is  
2 indexed through the collection spots of the concentric tracks by the stepper motor to allow  
3 numerous collections of the aerosol sample to be performed during displacement of the  
4 sample plate and the plurality of passages relative to one another.

1           10. The aerosol sample detection system of claim 4, wherein the sample plate has a  
2 plurality of groups of spaced apart ventilation holes, each group of ventilation holes being  
3 arranged to surround a respective one of the collection spots of each of the concentric tracks  
4 on the sample surface of the sample plate.

1           11. The aerosol sample detection system of claim 1, wherein the sample surface  
2 includes a substrate selected from the group consisting of charcoal or adhesives.

1           12. The aerosol sample detection system of claim 1, wherein the plurality of passages  
2 extend substantially parallel to one another and are spaced asymmetrically relative to a  
3 symmetry axis of the housing to provide parallel multiple flows of aerosol sample through the  
4 housing.

1           13. The aerosol sample detection system of claim 2, wherein the housing has a  
2 modular configuration extending along a symmetry axis and including a base configured to  
3 house the pressure source spaced axially downstream of the sample plate, an intermediary air  
4 intake part of the housing provided with the plurality of passages and covering the sample  
5 surface, and a cover topping the intermediary air intake part, wherein the base, the  
6 intermediary air intake part and the cover coextend with one another in a plane perpendicular  
7 to the symmetry axis and are detachably coupled to one another.

1           14. The aerosol sample detection system of claim 13, wherein the base of the housing  
2 is provided with multiple air outlets and has a recessed surface shaped and dimensioned to  
3 receive the sample plate.

1           15. The aerosol sample detection system of claim 13, wherein the intermediary air  
2 intake part of the housing has a lower flat surface covering the recessed surface of the base  
3 and an upper surface having a flat bottom spaced from the lower flat surface and a pair of  
4 flanges spaced across the flat bottom and extending axially upwards therefrom.

1           16. The aerosol sample detection system of claim 15, wherein the cover abuts the pair  
2 of flanges and is provided with at least one spacer extending axially toward and pressing

3 against the flat bottom, the at least one spacer being dimensioned to form a pair of air  
4 channels defined between the at least one spacer and a respective one of the pair of flanges.

1 17. The aerosol sample detection system of claim 15, wherein the pair of flanges each  
2 have a respective cutout region extending laterally inwards toward the cutout region of the  
3 other flange and traversed by a respective one of the plurality of passages leading into the  
4 recessed surface of the base and terminating upstream of the sample surface of the sample  
5 plate.

1 18. The aerosol sample detection system of claim 15, wherein the cutout regions each  
2 have a respective substantially triangular shape and is provided with a respective apex spaced  
3 from the symmetry axis and located next to an intake port, which is formed in each of the  
4 cutout regions and is in flow communication with a respective one of the plurality of the  
5 passages traversed by the aerosol sample.

1 19. The aerosol sample detection system of claim 18, wherein the cutout regions are  
2 non-uniformly dimensioned to have the apexes thereof spaced asymmetrically relative to the  
3 symmetry axis.

1 20. The aerosol sample detection system of claim 1, wherein the sample surface is  
2 made from a micro-porous material including frit or filter configured to trap particulates  
3 entrained in the aerosol sample.

1 21. An aerosol sample detection system comprising:  
2 a radio controlled unmanned aerial vehicle (RC UAV); and,  
3 an aerosol collector removably mounted to the RC UAV and operative to collect  
4 multiple aerosol samples.

1           22. The aerosol sample detection system of claim 21, wherein the RC UAV has a  
2 control panel spaced equidistantly from a plurality of rotary blades, the aerosol collector being  
3 coupled to the control panel.

1           23. The aerosol sample detection system of claim 21, wherein the aerosol collector  
2 comprises:

3           a housing having an interior;

4           a plurality of passages formed in the housing and configured to simultaneously  
5 provide multiple flows of aerosol sample into the interior thereof from ambient; and

6           a sample plate removably mounted in the interior of the housing downstream of the  
7 plurality of passages and having a sample surface, which is juxtaposed with the plurality of  
8 passages, the sample surface and the plurality of passages being rotatable relative to one  
9 another to form multiple concentric tracks of collection spots of the aerosol sample on the  
10 sample surface upon impacting the multiple flows of the aerosol sample thereagainst.

1           24. The aerosol detection system of claim 23, further comprising:

2           a pressure source mounted in the housing downstream from the sample plate to  
3 provide pressure differential between the interior of the housing and the ambient, which is  
4 sufficient to force air along the plurality of passages into the interior of the housing; and,

5           a stepper motor mounted in the housing and coupled to the sample plate to displace the  
6 sample surface relative to the plurality of passages, each of which is configured to have a  
7 respective downstream outlet port, wherein the outlet ports of the plurality of passages are  
8 spaced asymmetrically relative to an axis of symmetry of the housing to form the multiple  
9 concentric tracks of collection spots.

1           25. The aerosol detection system of claim 23, further comprising a time of flight  
2 (TOF) mass analyzer removably coupled to the sample plate and provided with multiple  
3 channels, wherein the multiple concentric tracks formed on the sample surface of the sample

4 plate each are indexed through a respective one of the multiple channels of the TOF mass  
5 analyzer.

1 26. A method of detecting an aerosol sample comprising the steps of:  
2 mounting an aerosol collector to a radio-controlled unmanned aerial vehicle; and  
3 creating a negative pressure within the aerosol collector, thereby collecting the  
4 aerosol sample during a flight of the radio-controlled unmanned aerial vehicle.

1 27. The method of claim 26, wherein the step of mounting the aerosol collector  
2 comprises the steps of:  
3 providing a housing centered along a symmetry axis;  
4 providing a plurality of passages extending through the housing and configured to  
5 simultaneously guide multiple flows of the aerosol sample through the housings;  
6 removably placing a sample plate within the housing so that a sample surface of the  
7 sample plate opposes downstream ends of the plurality of passages; and,  
8 rotating the disk during a flight of the aerial vehicle relative to the plurality of  
9 passages, thereby forming concentric tracks on the disk, each of which has a respective array  
10 of collection spots of the aerosol sample.

1 28. The method of claim 27, further comprising the steps of:  
2 removing the sample plate from the housing; and,  
3 loading the sample plate into a time of flight (TOF) mass analyzer provided with  
4 multiple channels, wherein the multiple concentric tracks each are indexed through a  
5 respective one of the multiple channels of the TOF mass analyzer.

1 29. The method of claim 28, wherein the step of loading comprises the step of  
2 redundantly assessing the aerosol sample collected on a group of spaced across the sample  
3 plate collection spots of the multiple concentric tracks.

- 1           30. The method of claim 26, wherein the step of rotating is provided in a time- and
- 2 speed-controlled manner, thereby indexing each collection spot of the multiple concentric
- 3 tracks, the method further comprising the step of continuously powering the sample collector
- 4 during a flight of the radio-controlled unmanned aerial vehicle.